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A PERIODICAL SURVEY OF NEW DEVELOPMENTS IN THE CONTROL OF PESTS, DISEASES AND WEEDS

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Fig. 4. *Sugar-cane ratoons which have been dusted with a* 4% *BHC dust made from* '*Agrocide*' 15*W to control Froghopper nymph. The position of the dust after application can be seen.*

Inset

ERRATA. Vol. 3, No. 3 "Plant Protection Overseas Review".
On page 26, paragraph 3, first word in line 7, for "who" read "he".
On page 37, under "Field Notes on Use of the Herbicide IPC", in the second line, for "carbonate" read "carbamate".

EDITORIAL

THE cultivation of the grape vine in Egypt and descriptions of the pests and diseases attacking the crop in that country are subjects of two articles in this number of the *Overseas Review*. Although vine culture was practised in Egypt in ancient times, the industry was abandoned for many years and was revived only within the last two decades. It is thought, therefore, that these two articles by leading authorities in vine culture in Egypt should be of special interest to our readers, especially those directly concerned with viticulture.

We publish also an article on Weed Research in Australia by a writer with expert knowledge of the subject, which should be of world wide interest. This article has been reprinted from the Fungicide and Insecticide Research Co-ordination Service Abstracts and News Summary of the Agricultural Research Council, United Kingdom, by kind permission of this organisation and the author of the paper. It forms one of a series on research on and methods of weed control in different countries, which was started in Vol. 1, No. 3 of this *Review*. We hope to publish in future issues of the *Overseas Review* further papers on this important aspect of plant protection in other countries, and contributions from our readers on this subject will be most welcome.

VITICULTURE IN EGYPT

by C. CONSTANTINIDES, B.Sc. (Glasgow)
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TYPES OF GRAPES

CULTIVATED grapes in Egypt are of the species *Vitis vinifera*. The various types are as follows :—

(1) Wine grapes.
(2) Table grapes.
(3) Raisin grapes.

The juice of any variety could be fermented into wine, or the fruit eaten fresh, or dried to form raisins. Each variety is, however, most suited for one particular purpose.

Wine Grapes. These are generally medium to small in size. Red wine, both dry and sweet, is made from the grapes of coloured skin. The production of sweet wines requires a grape with a high sugar content and low acidity. For dry wines, a grape with higher acid and moderate sugar content is needed.

The Cleopatra (Noir de Cypre), Belti of Tunis and Muscat are grown as wine varieties in Egypt.

Table Grapes. . These must be attractive and of the desired quality as far as colour, flavour, size, form and texture are concerned.

The varieties of table grapes grown in Egypt are :—Italia, Rosaki, Sultanine, Fayoumi, and Red Roumi.

Table grapes require good soils and a moderately warm climate if they are to attain the required characteristics making them attractive to the customer.

Raisins. These are produced from the highest quality raisin grapes and are grouped as follows :—

(1) *Raisins Proper*, the majority of which are produced from the Muscat of Alexandria, or its variations. The Muscat Gardo Blanco and other large sweet white varieties are sometimes used.
(2) *Sultana Raisins*, made from the Sultanine grapes (seedless).
(3) *Currants*, produced from the very small, seedless Black Corinth grape, and to a less extent from the somewhat larger White Corinth.

The production of raisins is undeveloped in Egypt, probably because there is a greater demand for fresh grapes.

Dried Grapes. These are made from almost any kinds of grapes, and are produced in large quantities when the price for fresh grapes is low. They are used for such purposes as the manufacture of imitation wines and their by-products.

VARIETIES OF GRAPES GROWN IN EGYPT

There are a large number of grape varieties grown in Egypt, and the most important are the following :

Early Varieties. Fayoumi, Sultanine, Khaliti, and Baladi.

Mid-Season Varieties. Italia, Delicia, Rasaki, Biz El Naka, Muscat d'Aden, Muscat d'Alexandrie, Noir de Cypre, and Belti of Tunis.

Late Varieties. Red Roumi, White Roumi and Charibi.

Very Late Varieties. Yohanes de Rio, and Hadidi.

Soil Requirements.

Sandy loams are the most favourable types of soil for grapes. They are very early, easily worked, easily drained, respond to heavy dressings of manure and can store large quantities of water.

Climatic Conditions

The grape vine is a plant of the semi-arid, sub-tropical regions and prefers a hot, dry summer and a wet winter. A mean daily temperature in winter between 1° and 10°C and in summer from 22° to 29°C may be considered as favourable. Excessively high temperatures (40°C or over) may cause damage, especially in vineyards planted on high soils and not irrigated.

An average annual rainfall of 24 in., well distributed, is usually sufficient. In certain localities in Egypt, rain is rare, and in others there is no rainfall, so that all vineyards in the country are planted on levelled land to facilitate irrigation.

Extent and Distribution of Vineyards

The area planted with vines in Egypt is about 18,000 acres, about 8,000 acres along the banks of the Nubarieh Canal (some 80 kilometers in length), 4,000 acres in the Fayoum district and the remaining 6,000 acres distributed in the provinces of Menoufia, Dakahlia, Sharkia Assiut, Girga and Kenna.

PROPAGATION AND CULTIVATION OF VINES IN EGYPT

(1) *Cuttings.* The most common method of propagation, which has proved successful and economical, is by cuttings. The cuttings are sometimes planted directly in the vineyards, but are often rooted in a nursery for one year and then planted out early in the second year in the vineyard.

The cuttings should be taken from healthy bearing vines. The best wood for cutting is that of the one year old dormant wood of medium size and with moderately short joints. They should be 15 to 23 inches long, the shorter ones for moist soils in cooler localities, the longer ones for drier soils in hot regions.

The vines from which the cuttings will be taken must be examined while they still bear their leaves and fruits, to ensure that they are healthy and of the desired variety. Canes from young vines or from vines that have given excessive crops are often ill nourished, and will probably fail to grow, or grow poorly.

The cuttings are taken from vines which have been pruned a few days after their leaves have fallen (this period in Egypt is about the middle of January). They are collected into bundles and securely tied with the buds at the same level. They are then buried carefully in a sand bed or ditch and carefully covered by a layer of sand (3 in. to 4 in. deep). When placing the bundles in position, ensure that each cutting is surrounded by sand.

If there is no rainfall, the bed should be regularly irrigated to keep it moist. In some cases, cuttings are taken from the mother plant during the planting season, when they are planted as soon as possible to avoid drying.

(2) *Grafting.* Propagation of grapes by grafting is not common in Egypt, due to the absence of *Phylloxera.* The process consists of grafting cuttings with one or two buds on to a 9 or 12 inch resistant cutting from which all the buds have been removed. The graft is united in a callusing bed, rooted in the nursery and planted out in the vineyard when one year old.

(3) *Layering.* This method is commonly used to replant missing plants in the vineyard. A vigorous branch is chosen and trained for this purpose from the plant adjoining the vacant space. The following spring, the trained cane is bent and planted in the place of the missing vine. After a year or so, when the cane has developed into a young plant, with its own root system, the plant is cut from its mother.

Planting. After the cuttings have been rooted in a nursery for a year they are planted out in the vineyard. In a well prepared moist soil they may be planted directly in the vineyard, two buds being left above the soil surface. The soil should be ploughed as deeply as practicable before planting.

Distance. If the plants are to be head pruned (gobelet) they should be grown at a distance of 2 x 2 metres ($6\frac{1}{2}$ x $6\frac{1}{2}$ ft.), and if they are to be trained on wire the distance should be 3 x 1.40 metres (10 x $4\frac{1}{2}$ ft.).

All young vines should have supports ; in the case of head pruned vines these supports are temporary and removed after a number of years. In the case of vines trained on wires, the wires are permanent and the height and distance of the stakes are dependent on the system of training and pruning to be followed.

PRUNING AND THINNING

Grapes have different types of growth, the most important in Egypt is the vase form (head pruning), followed by the cordon and the arbor forms of pruning.

Head Pruning. In the first year the vines need no attention, except thorough cultivation and necessary irrigation. In the following winter the dormant growth is thinned to one cane, which is cut back to two buds. The vines should then be staked. During the

second year all buds or shoots, but one, should be removed before they have made any considerable growth. The whole energy of the plant is thus forced into one shoot only, which should be carefully tied to the stake and, if vigorous, topped at 2½ feet to produce laterals. All suckers from below ground should be carefully removed at their origin to avoid big cuts and wounds at a later stage. At the second winter pruning, all canes but one should be cut off to the height at which it is desired to " head " the vine, which will be about 24 in. to 28 in. (61 to 71 cm.) for heavy growth vines.

Table grapes are as a rule headed higher than wine or raisin grapes. When strong laterals have developed, these should be left with two buds, at points where it is desired to develop arms. In the third year no shoots should be allowed to develop on the trunk of the vine within 15 in. of the soil, and according to the height of the desired head. It is usually necessary to pinch back all the young shoots from the head when they are about 20 inches (50 cm.) long to protect them from injury from the wind, while they are still brittle. At the end of this year, the plant should have developed sufficiently to carry three to six permanent arms in the positions desired.

During subsequent pruning operations, the number of permanent arms is gradually increased, until the vine is fully mature, the number depending on the variety and the planting distance between the vines. During the first three or four years of growth great attention should be given to developing a vine with a clean vertical trunk and symmetrically placed arms.

When applying this form of pruning (vase or gobelet) the " head " should be high enough from the ground and the arms spread wide enough apart to keep the fruit from contact with the soil and to spread out the bunches, so that they will develop, ripen, and colour evenly. The removal, soon after the grapes set, of water sprouts and sterile shoots which are not needed for new arms helps to make the bunches and berries larger, by concentrating the energy and growth of the vine in the bearing shoots.

Cordon Pruning. This method of pruning is just beginning to be popular in Egypt. The system is being introduced in a number of estates, since it enables a considerable number of operations to be carried out mechanically, such as manuring, cultivation (summer and winter hoeing) and spraying. The common cordon vine pruning used (in Egypt) is the bilateral cordon. Here the vertical trunk is allowed to grow to a height of 24 inches, then branched into two horizontal branches in opposite directions and trained on the first row or wire of the trellis, which is at a distance of 27 in. (68.6 cm.) from the ground.

The arms or branches reach half way to the adjacent vine, and on the arms the necessary fruiting canes are allowed to form. Near and below the base of each fruiting cane is left a " renewal spur " con-

sisting of two buds, whose function is to supply a fruit cane and renewal spur for the following year.

Arbor Pruning. The vine is trained to climb an arbor. The head is then formed with the number of laterals required. These laterals are big branches arranged so as to cover the space required. They are trained so that they are clear from each other and equally spaced. Each branch is now pruned and treated as a cordon vine.

Systems of Pruning.

There are many systems of pruning, but the following three methods are considered to be the principal ones.

(1) Short Pruning
(2) Long Pruning
(3) Mixed Pruning.

The difference between short and long pruning is, that in short pruning two to three buds only are left on each cane, whereas in long pruning more than three or four buds are left.

Mixed pruning involves leaving on the same plant canes which have been both short and long pruned.

It is important to note that a bud of the short pruning system gives rise to one shoot carrying two bunches of grapes, whereas a bud of the long pruning system and at a certain distance from the base may give rise to one shoot which will branch off into two or three laterals giving three or four bunches of grapes.

Long pruning will give more fruiting shoots and grapes than the short pruning but it produces longer dormant wood with less vigorous fruiting canes and in a few years weakens the plant.

Choosing the system of pruning depends on the variety of the vine, the soil and climatic conditions. Certain varieties such as the Red Roumi have all their buds fertile, beginning from the base of the fruiting cane. Other varieties, on the contrary, such as the Sultanine, have the buds near the base of the fruiting canes generally infertile, the most fruitful buds being a certain distance from the base of the cane. Such varieties of grape require long pruning.

Influence of Climate.

When the climate is hot and there is no danger of frosts in spring, the " head " is formed in the vase shape type of pruning so that it is not far above the soil. This protects the soil from too rapid drying and the grapes from being adversely affected by the sun's rays. On the other hand, when the region is humid, we form the " head " of the vase shaped pruning higher to ensure aeration and lessen the danger of attack by disease.

Time of Pruning

Pruning is carried out during the resting season, and is essential because it gives the required shape to the vine for economical culture, and concentrates the plants' activities in the remaining shoots.

SOIL CULTIVATION

The vineyard soil should be kept loose and free from weeds, both during winter and summer, but especially in summer. The soil can be worked mechanically or by hand. Winter hoeing is much deeper than that carried out in the summer in order to kill noxious deep rooted weeds and grasses, aerate the soil and create favourable conditions for the development of soil bacteria. Certain growers, while carrying out winter cultivation, open ditches between the rows of vines, into which farmyard manure and other organic fertilizers are put.

Manuring (Organic and Inorganic Fertilizers)

Well rotted farmyard manure is known to be the best fertilizer, due to its organic matter (humus) content. This is especially recommended for light sandy soils. As it is slow acting, it should be applied in December/January at 15 tons per acre. Other organic fertilizers available are cotton seed cake, Poudrette, dried blood and town refuse.

Where organic fertilizers are difficult to obtain, chemical fertilizers may be substituted.

Chemical fertilizers are of three types :—

(1) *Nitrogenous*, which are quick acting, are applied to vines twice, first at the end of February, and again a month later. The recommended quantity per feddan for one application is 75 kg.

(2) *Phosphatic*, containing P_2O_5 in the form of soluble calcium phosphate as the active element. The recommended quantity is 150/200 kg. per feddan.

(3) *Potassic*, applied at the rate of 40 kg. per feddan.

Both phosphatic and potassic fertilizers are slow acting and, therefore, should be applied by February.

The fruits (grapes) absorb a comparatively small proportion of the food materials. Vineyards, therefore, do not deprive the soil of large quantities of food materials if the vine grower returns to the soil the leaves and canes. In this case very little manuring would be necessary.

Irrigation.

As Egypt has a low rainfall, all vineyards are irrigated throughout the year, as and when required. The number of irrigations given depends on the structure of the soil. Well drained sandy, or deep loamy soils, need more irrigation than heavy soils.

The first irrigation, which is given in the winter before the vines start to grow, is considered the most important irrigation, and it is generally a heavy one, spring and summer irrigations being lighter. Heavy irrigation and favourable atmospheric conditions encourage the development of diseases. Irrigation should cease as soon as the fruit begins to colour.

One to two irrigations are given after harvesting, which is sufficient until the following spring.

PESTS AND DISEASES

The Most Important Pests attacking Vines in Egypt are :—

(1) *Polychrosis botrana.* (The Grape Berry Moth).

The larvae of the moth are small slender caterpillars, pinkish in colour, which attack the vine branches, causing great damage if uncontrolled.

The berry moth larvae spin silky webs between the flowers and destroy many of them.

Methods of Control.

Satisfactory results have been obtained by spraying with a solution of 0.3% ' Arsinette ' (3 lb. per 100 gallons of water), as soon as the moths of the first generation appear. The incidence of the pest is best ascertained by setting traps. The same treatment is carried out for the other generations.

' Didimac ' 10 dust or ' Didimac ' 50 dispersible powder also give good results.

(2) *Prodenia litura* (Cotton Leaf Worm)

In the delta area, the cotton leaf worm is considered a most serious pest to vine growers, since the caterpillar attacks vineyards during the months of June and July. It is successfully controlled by a spray solution of 3 lb. ' Arsinette ' per 100 gallons of water. This application will also control the berry moth.

(3) *Pseudococcus citri* (Mealy Bugs).

This is a serious pest in certain vineyards, causing great damage to the fruit. For control, a spray of 75 cc. ' Fosferno ' 20 per 100 litres (12 fl. oz. per 100 gallons) of water give satisfactory results.

(4) *Phytoptus vitis* (Erinose).

The vine mite attacks the underside of the leaves producing galls, which are at first of whitish colour, but later become brown. They attack the vines early in spring, and are considered a very serious pest. They are easily controlled by dusting with sulphur.

(5) *Scales.*

Egyptian vines are sometimes attacked by scale insects. Such attacks are controlled during the dormant season by spraying with a 2% solution of ' Alboleum.'

The Most Serious Diseases which Attack Vines in Egypt are :—

(1) *Perenospora viticola* (Downy Mildew).

The Downy Mildew is the most important fungus disease for the Egyptian vine grower. It attacks the leaves and fruit, and in advanced cases the young stems and canes, to such an extent that the plants dry up and die.

Control. A regular protective spraying programme is carried out from the month of April onwards, at approximately three-weekly intervals, with a copper fungicide. ' Perenox ' at the rate of 350 grms. per 100 litres (3½ lb. per 100 gallons) of water has proved to be very effective.

Three to five sprays are carried out according to varieties (early or late) and climatic conditions.

(2) *Oidium* (Uncinula Necator).

The powdery mildew is the second most important disease on vines. It attacks the young shoots, leaves and fruit of the grape, the variety Red Roumi being particularly susceptible.

Control. Powdery mildew is easily controlled by applications of dusting sulphur, or by a spray of dispersible or wettable sulphur. The remedy is applied immediately after the disease appears, and not, as in the case of downy mildew, as a protective measure before the disease appears.

(3) *Guignardia bidwellii* (Black rot).

The black rot is a fungus disease attacking all succulent organs of the vine, starting in the leaves and extending later to the fruits.

Control. Black rot, as in the case of Downy Mildew, is controlled by copper fungicides, but in this case it is necessary to give more sprays and at different periods.

(4) *Sooty Mould* (Fumagine).

This is a fungus which appears as a secondary disease, and attacks all parts of the vines where the sugary excreta from mealy bugs, larvae of scale insects, etc., are present. It is not a very important disease unless the fruit is attacked.

Control. To control Sooty Mould, it is necessary to control the insects responsible for the secretion of the honey-dew.

(5) *Stereum* sp. (Esca).

A fungus that enters the cut ends of branches after they have been pruned and then penetrates into the trunk. During summer the vine suddenly dies. Before death, the wood of the trunk turns reddish brown and spongy. The main branches break off easily.

Control. Five days after pruning in winter, a spray or brushing of the wounds with a 3% solution of Sodium Arsenite is recommended.

CONCLUSION

Viticulture was practised in Egypt in the time of the Pharaohs, but with the passage of time became neglected. In the last twenty years, however, the industry has been revived and is still expanding. The estimated annual crop has now reached the 55,000,000 Okes mark.

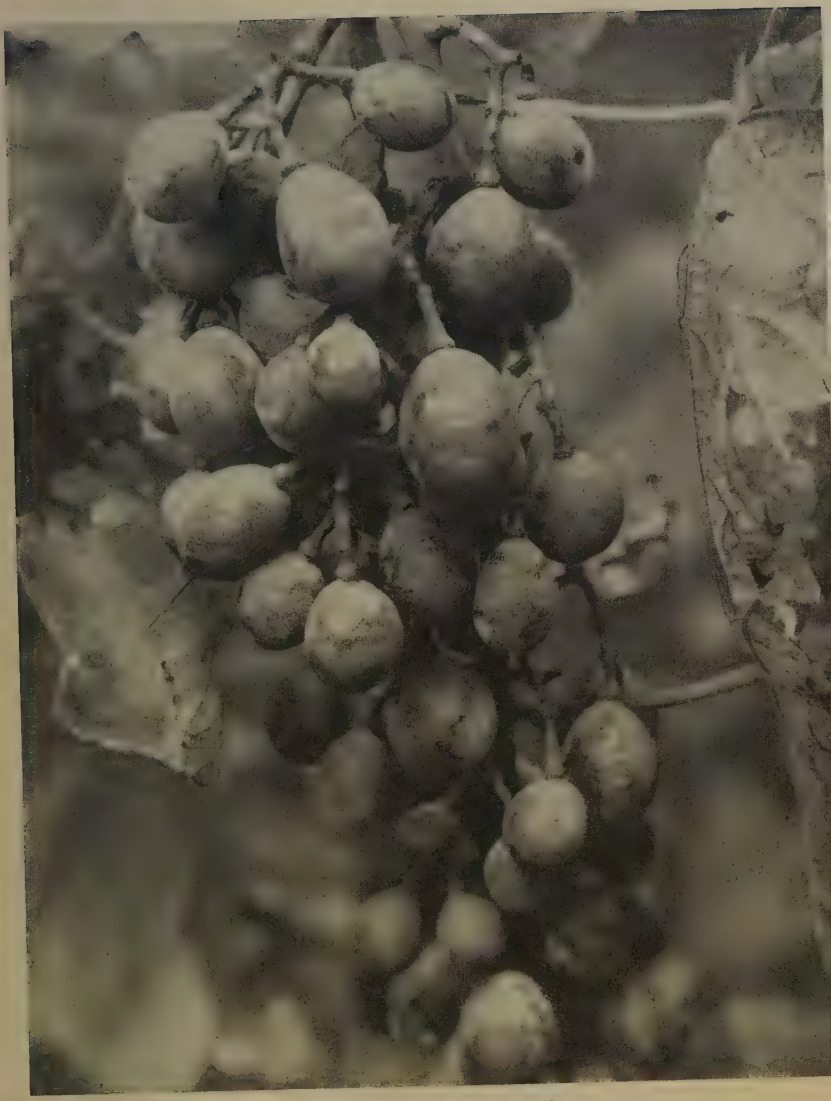

Fig. 1.—*Powdery mildew* (Oidium) *on grapes.*

Fig 2.—Grape berry moth (Polycrosis botrana) *damage on grapes.*

CONTROL OF SOME VINE DISEASES AND PESTS IN EGYPT

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SUMMARY

THE aim of this article is not to cover all the diseases of the vine nor to give a technical description of the organisms causing the diseases described, which can be found in standard books on viticulture. It aims to give short descriptions of two phenomena, one meteorological and the other related to the soil water table, their effects on the vine and suggestions as to the prevention or control of these effects.

In dealing with two common parasitic diseases and two insect pests, which co-exist during the summer, the aim is to recommend a combined spray of copper, sulphur and insecticides which the writer found to give good results.

INTRODUCTION

The vine has been grown in Egypt more or less systematically only in recent years. It is true that the vine was growing in North Africa and in Egypt at Mariout in ancient times, but there is no evidence as to the continuity of the existing vine industry with that referred to by historians.

The aim of this article is to pass on information to the viticulturist of Egypt and countries of similar climatic conditions concerning the damage done to this industry by certain physiological and fungus diseases and insect pests, and to give suggestions for their control based on the experience of the writer.

Egyptian viticulture is chiefly concerned with table varieties, with the exception of one estate which grows also grapes for the wine industry.

All varieties grown in Egypt are of the *Vitis vinifera* (*Linné*) type. Propagation is carried out by cuttings. Grafting on American Phylloxera resistant stocks is not practised as Phylloxera does not exist in Egypt, probably owing to irrigation and soil conditions.

We can define disease as a deviation from the plant's normal life which prevents its proper development in one direction or another. When we come to consider the causes we can divide them into parasitic and non-parasitic causes.

I shall confine myself to two of the most harmful non-parasitic causes, peculiar to Egyptian conditions of climate and soil, two diseases caused by fungi and two insect pests.

NON PARASITIC CAUSES

HAMSIN

Meteorological explanation.

When pressure is highest over the Red Sea Desert, we invariably have hot winds in Egypt. They blow into the depression and give rise to ascending currents which raise clouds of dust, each particle of which intercepts the sun's rays and becomes a focus to increase the patch of heat. A cyclonic storm always follows. At first the wind veers to north-east or east, when the storm centre lies over the central Mediterranean, then it swings round to south-east, south and south-west, as the storm advances eastwards. When the trough passes and pressure begins to rise again, the wind changes abruptly to north-west, temperature falls, humidity rises and the dust-laden air is swept away as if by magic.

Damage

During hamsin the damage to the vine is done by excessive heat, the moving sand and the strong wind.

The heat will wilt young shoots and burn the bunches.

The moving sand will cover swollen buds before they open, and scorch leaves and green shoots.

The strong wind will break green shoots, especially those which have not had time to become lignified and strong enough to support the force of the wind.

Control Measures

Unfortunately there are no real control measures to be done during the hamsin for the vines grown in the Western Desert, but certain precautions can be taken when the vine-yards are established and also before the period of hamsin starts.

These measures and precautions are :—

1. Always establish an effective wind-break before planting the vine to give protection against the moving sand and strong winds.
2. Vines should always be well supported with strong supports before the period of hamsin starts.
3. Top all long bearing shoots before that period if possible, as extra length is always the cause of breakages.
4. Contrary to the practice in Europe, the bunches should be well covered with leaves to avoid exposure to direct excessive heat.

5. Try to ensure by irrigation and hoeing that during the hamsin period the soil moisture content is high enough to make good all the extra loss of moisture through the leaves and weeds owing to the excessive heat. Otherwise a permanent wilting of young shoots may be unavoidable.
6. Never apply sulphur in any form during hamsin, as sulphur may cause heavy damage through burning during the period of excessive heat.

EFFECT OF HIGH SOIL WATER TABLE AND OBNOXIOUS SALTS ON VINES

The vine grows successfully in Egypt on land with a water table about two metres below soil level, free from obnoxious salts and with a PH 8.5 or less. But if by mistake the vine is planted on land not fulfilling the above conditions, or if soil conditions for reasons beyond the farmers' control have deteriorated after the vine has been established, and the water table has risen above the two metre level, obnoxious salts infiltrate into the root horizon, the PH value rises above 8.5, and gradual poisoning is unavoidable, with ultimate killing of the plant, unless necessary precautions are taken in time.

Symptoms of such effects are :

1. Delay of opening of the eyes from dormancy in spring.
2. Most of the leaves do not grow to full size and the young shoots remain stunted.
3. Gradual chlorosis and dropping of leaves and final death of the plant.

Control

1. Be sure to plant on land fulfilling the soil conditions required by the vine, and ensure good drainage and freedom from obnoxious salts.
2. But if this has been overlooked or conditions have changed, on the first appearance of the symptoms carry out a thorough examination of the soil and, if the symptoms are due to the soil, then open drains and flood the land to leach off salts.

PARASITIC DISEASES
PERONOSPORA VITICOLA

In neighbouring countries like Israel, Syria, Cyprus, Turkey and Greece, *Peronospora* is not dangerous every year. It is only dangerous in very wet rainy summers with sudden changes of temperature and little sunshine. Its appearance is practically always associated with late rains in May and sometimes in June. But such rains in May or June are not common every year.

In Egypt, *Peronospora* of the vine is endemic and makes its appearance every year as soon as summer humidity rises from July onwards, especially in the Northern Provinces of Lower Egypt.

But occasionally in years when it rains late in May, severe attacks of *Peronospora* may start in late May and June, instead of July as usual.

Some early varieties like the " Sultanine " and " Queen of Vineyards " escape the attack of *Peronospora* of the endemic form, as the grapes are already ripe by July and are only effected by the early *Peronospora* associated with the late rains of May and June.

The disease, if not treated in time and carefully prevented, may have disastrous effects on the crop and on the plant itself.

Control

Winter Treatment

1. Cover well all fallen leaves by hoeing deeply with the Egyptian hoe or spade. If spacing between rows allows passage of a tractor, cultivate with a disc harrow to ensure that the leaves are completely covered.
2. Scrape off the loose bark from the stem. Burn the scraped off bark. The burning of the loose bark destroys hibernating forms of many fungi and insects.
3. Paint the stem with 5% Bordeaux Mixture by means of a brush and, to control insects, spray with an insecticide like ' Ovicide ' of Plant Protection Ltd.

Summer Treatment

Spray with either a copper spray, such as ' Perenox,' at a dilution of 0.4%, or 1% Bordeaux Mixture.

Give the first spraying when first shoots have attained a length of 15 to 20 centimetres. Repeat the spraying every 15 days up to 4 sprayings. Repeat spraying after rains.

The aim of the four sprayings is to cover all leaves, especially the lower surfaces, with the copper spray before the leaf is attacked by the fungus.

Late varieties like the Roumi Ahmar are most likely to suffer by late attacks if the spraying is not carried out properly.

Copper sprays will also protect the vine against fungi of minor importance like the black and brown rot.

OIDIUM OR POWDERY MILDEW

This disease, like *Peronospora*, is indigenous to North America. It came to Europe early in the 19th century and from there to Egypt.

It attacks chiefly the berries and damages them by the characteristic cracking.

Some varieties, especially the late variety Roumi Ahmar, are very susceptible to this disease.

Control

Sulphur is the only effective control against oidium. It should be applied early and repeated every fifteen days, if possible till maturity. The bunch should be well covered. The writer prefers to apply it as a spray as in this form it reaches all the berries more readily. As a dust it is difficult to reach each bunch. 1% wettable sulphur could be incorporated in the copper spray and be applied at the same time as the latter. Avoid spraying during hot days.

INSECT PESTS

THE COTTON LEAF WORM

The cotton leaf worm attacks in the summer practically all crops and has a special liking for the vines. If not controlled it may eat all the leaves, tender shoots and stalks of bunches, thus causing them to drop. It is the most dangerous major pest in Egypt.

THE GRAPE BERRY MOTHS

(*Eudemis—Polychrosis Botrana*)

The Grape Berry Moth has become a very dangerous major insect pest of the vine in late years, although there is evidence that the insect was recorded in Alexandria gardens before 1926.

There are three generations every year, but the damage is not apparent except in the second and third generations.

The first generation appears early in April and sometimes attacks the bunches before the flowers open. The damage is not easily seen unless one looks carefully for the characteristic web in which the undisturbed larvae eat the non-formed berries and their tiny stalks. Each attacked bunch may have from one to ten such webs. The first generation usually prefers well developed young bunches of early varieties like Sultanine, Italia and Zamaica.

The second and third generations usually attack ripe berries. One larva may attack several berries by travelling in the inside of the berry from one to the other at the point of contact. The damage is aggravated by the development of saprophitic fungi in the juice escaping from the attacked berries and sometimes by the attack of saprophitic insects on rotted berries. In severe cases the whole bunch becomes a rotted solid mass unfit for sale.

The following system of control was developed by the writer as giving the best results for both the cotton leaf worm and the berry moth.

The first spraying against *Peronospora* and *Oidium* is carried out at about the end of March or beginning of April.

To control at the same time the first generation of berry moth, which appears at the same time, and to protect the leaves against any eventual

early appearance of cotton worm the following mixture is recommended :

0.4% ' Perenox ' or 1% Bordeaux
1% Sulphur
0.3% Lead Arsenate
1% Spreader

The second spraying will be applied after the appearance of second generation *Eudemis* moths in traps. This usually will be early in May and the mixture recommended then is the same except that it is advisable to replace the lead arsenate with DDT dispersible powder, 25 to 50% at the strength recommended by the manufacturers.

A third spraying is recommended with the same mixture after 15 days.

As indicated by traps, as soon as the moths of the third generation appear on late varieties the fourth spraying should be made, replacing the DDT by ' Fosferno ' 20, 1-2000. The reasons the writer prefers ' Fosferno ' 20 for the last spraying are :

1. Most of the varieties being near maturity, there should not be residues of either lead arsenate or DDT on the berries. ' Fosferno ' is recommended as it does not have a prolonged residual effect, but it should not be applied within four weeks of harvest.
2. As the second and third sprayings contain DDT, which from the experience of the writer, encourages the propagation of mealy bugs by killing its parasites, ' Fosferno ' will not only kill the cotton worm and berry moth larvae but also prevent the eventual appearance of mealy bugs on the aerial part of the plant.

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SUGAR-CANE FROGHOPPER CONTROL IN TRINIDAD

Season 1952

As control measures against froghopper attack in Trinidad, involving the use of 'Agrocide' formulations, have been carried out during 1952 on a scale larger than ever before, and as this is the third year during which 'Agrocide' has been used against the nymphs on an estate scale, it is considered that the following summary of a report by Mr. T. E. K. Potter of the Agricultural Department of Messrs. T. Geddes Grant Ltd., Trinidad, on the results obtained up-to-date from this method of control would be of interest to readers of the "Plant Protection Overseas Review."

Incidence

Froghopper attack was unusually severe during 1952. Farmers' canes, as well as comparatively new cane areas and young plant canes on estates carried heavy infestation.

It has been suggested that the extensive use of insecticides in the control of the pest and the possible resulting elimination of beneficial insects may be the reason for the increased infestation. Facts which do not lend support to this contention, however, are that areas far removed from estate lands and which have never been treated with insecticides have suffered with severe blight and that Diatraea borer infestation has not increased on estates which have been using 'Agrocides.'

Control Measures

A 4—5% BHC 'Agrocide' formulation has been applied at the rates of 1½ to 4 cwt. per acre around the bases of stools on all estates for nymph control. "Drift dusting" by means of power dusters working at the sides of the fields has also been used against adults which have commenced to 'blight' cane fields too heavy to allow entry.

It has been calculated that the total cost of the control measures was approximately $13.00* per acre, equivalent to just under 30 cents (1s. 3d.) per ton of cane based on the 1953 crop estimate.

Results

On most of the estates using 'Agrocide' against froghopper, completely satisfactory control has been obtained. The programme on the

*B.W.I. currency, $4.80=£1.

estate with the most effective control has been as follows :—

1. All fields are under a weekly observation from May 1st to close of season.
2. The formulating of the powder is under strict supervision and a running daily balance is made of the stocks of Concentrate, Limestone and formulated powder.
3. Once per fortnight, the formulated powder is analysed for BHC content.
4. Monthly cage trial tests are made with the ' Agrocide ' formulation against froghopper nymphs and adults to determine any possible genetical resistance being bred by the insect.
5. Each section Manager is held responsible for the control in the area under his supervision. In the event of froghopper damage, an explanation must be given by him in writing.
6. Dust application is made early in the life of the ratoon canes, especially where an infestation is expected or where nymphs have been reported.
7. Such confidence exists in ' Agrocide ' for froghopper control that today- *the criterion of an efficient manager is no ' blight ' in the section under his control.*

On the estate which treated the largest area, froghopper control is considered an integral part of successful sugar-cane cultivation, and less than 1% of the total area under cane has suffered damage from the pest.

Where management is prepared to enforce supervision, both in preparing the formulation and in its application, satisfactory and economic control of the pest can be obtained.

Although the froghopper is a major pest of sugar-cane only in Trinidad, this report should be of general interest in that it demonstrates clearly the success that can be achieved in the control of a serious crop pest by careful organization and supervision of a control programme by plantation managements.

Fig. 3.—Sugar-cane Froghopper nymph control. Dusting ratoons with a 4% BHC dust made from 'Agrocide' 15W.

Fig. 4.—*Sugar-cane ratoons which have been dusted with a* 4% *BHC dust made from* ' *Agrocide* ' 15*W to control Froghopper nymph. The position of the dust after application can be seen.*

WEEDS RESEARCH IN AUSTRALIA

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Taken from "FUNGICIDE AND INSECTICIDE RESEARCH CO-ORDINATION SERVICE ABSTRACTS AND NEWS SUMMARY" SECTION "C"—HERBICIDES—No. 5, prepared by the Agricultural Research Council Unit of Experimental Agronomy, Cunard Building, 15, Regent Street, LONDON, S.W.1., and printed by H.M.S.O.

I. INTRODUCTION

PRIMARY production, the main source of Australia's wealth, is affected seriously by weeds of various kinds. Alien plants accidentally or purposefully introduced have followed the settler into the agricultural and pastoral regions of the continent. In 1939 Anderson (3) recorded 415 exotic species (excluding *Gramineae*) in the State of New South Wales alone, an increase of 89 % over the number listed by Moore and Betche (31) 45 years earlier. Whilst not all these species are weeds, Anderson's list includes the major weeds of New South Wales with the exception of the native *Bassia birchii*. Movements of stock are a regular feature of the Australian pastoral industry and have facilitated the distribution of weed species within the continent. The drastic modification of plant communities by killing of trees, soil disturbance and grazing of animals has enhanced the possibility of further invasions by exotic species.

From Table 1, which lists the major weeds of Australia, it is seen that introduced plants predominate.

Table I

IMPORTANT AUSTRALIAN WEEDS

Classification	Botanical Name	Common Name	Longevity	Origin
Pteridophytes	*Pteridium aquilinum* Kunth.	Bracken fern	Perennial	Cosmopolitan
Monocotyledons	*Aristida leptopoda* Benth.	White speargrass	Perennial	Native
	Arrhenatherum elatius var. *bulbosum* (Willd.) Spencer	Bulbous oat grass	Perennial	Europe, Nth. Africa
	Asphodelus fistulosus L.	Wild Onion	Perennial	Europe, Asia, Sth. Africa

Table I. IMPORTANT AUSTRALIAN WEEDS—*cont.*

Glassification	Botanical Name	Common Fund	Longevity	Origin
Monocotyledons	*Cenchrus tribuloides* L.	Sand-burr	Annual	Nth. America
	Cyperus rotundus L.	Nutgrass	Perennial	Cosmopolitan
	Eichhornea crassipes (Mart.) Solms.	Water hyacinth	Perennial	Nth. America
	Homeria collina (Thunb.) Vent.	One-leaved Cape tulip	Perennial	Sth. Africa
	Homeria miniata Sweet	Two-leaved Cape tulip	Perennial	Sth. Africa
	Nasella trichotoma (Nees.) Hack.	Serrated tussock	Perennial	Sth. America
Dicotyledons	*Alhagi camelorum* Fisch.	Camel thorn	Perennial	Asia
	Baccharis halimifolia L.	Groundsel bush	Perennial	America
	Bassia birchii F. Muell.	Galvanized burr	Perennial	Native
	Berkheya rigida Thunb.	African thistle	Perennial	Sth. Africa
	Cardaria draba (L.) Desv.	Hoary cress	Perennial	Mediterranean
	Chondrilla juncea L.	Skeleton weed	Perennial	Europe, Asia, Nth. Africa
	Cirsium arvense (L.) Scop.	Perennial thistle	Perennial	Europe, Asia
	Convolvulus arvensis L.	Field bind weed	Perennial	Europe, Asia, Africa
	Emex australis Steinh.	Spiny emex	Annual	Sth. Africa
	Eupatorium adenophorum Spreng.	Crofton weed	Perennial	Mexico
	Eupatorium riparium Regel	Mist flower	Perennial	Mexico
	Euphorbia terracina L.	False caper	Perennial	Mediterranean
	Gaura parviflora Dougl.	Clockweed	Perennial	Nth. America
	Hypericum perforatum L.	St. John's Wort	Perennial	Europe, Asia
	Lantana camara L.	Lantana	Perennial	Nth. America
	Rubus fructicosus L.s. lat.	Blackberry	Perennial	Europe, Asia, Africa
	Salvia reflexa Hornem.	Mintweed	Annual	Nth. America
	Senecio jacobæa L.	Ragwort	Perennial	Europe, Asia
	Solanum hystrix R. Br.	Afghan thistle	Annual	Native
	Vella annua (L.) Prantl.	Ward's weed	Annual	Mediterranean
	Verbesina encelioides (Cav.) A. Gray	Crownbeard	Annual	Nth. America
	Xanthium pungens Wallr.	Noogoora burr	Annual	Mexico
	Xanthium spinosum L.	Bathurst burr	Annual	Sth. America

In addition to the above there are, of course, a host of other species which are quite serious problems in localized regions or under particular land use systems. Weed problems of Australia have been reviewed by Currie (12, 14) and by Cashmore and Campbell (9).

Australian investigators have been concerned with problems of weed control for many years. Cashmore and Carn (7, 8), Morgan (42) and Prunster (54) made extensive studies with arsenicals and chlorates for the control of perennial weeds. Pot experiments were done by Neal-Smith (46) for comparison of chlorates, arsenicals and thiocyanates and by Morgan (43) for studying the effect of arsenicals on hoary cress. The absorption and translocation of arsenicals, chlorates and other compounds were investigated by Morgan (44), Greenham (22, 23) and Greenham and Wilkinson (24) ; time of day effects on the efficiency of acid arsenicals applied to skeleton weed were determined by Currie and Greenham (13).

Farmers were reluctant, however, to use chemicals with poisonous, soil sterilizing or inflammable properties and these compounds were not used extensively in agriculture. For some years prior to the war there had been a marked ecological trend in weeds research, as exemplified by the control of St. John's Wort by an introduced clover (32) and the successful use of improved pastures following mechanical treatment of blackberry, *Watsonia meriana* (L) Mill., bracken and ragwort (2, 53).

The outbreak of war and subsequent intensification of agricultural production resulted in renewed research on chemical methods, particularly for the control of weeds in vegetables and special crops such as flax. Sodium dinitro orthocresylate (Sodium salt of DNC) was used successfully in cereals and flax (10, 56), kerosene in carrots and parsnips (28, 58, 60), and copper sulphate in cereals (59). It was not, however, until the overseas discovery of the selective herbicidal properties of plant growth regulating substances that research on chemical control methods was intensified in Australia. Surveys of the potentialities of MCPA and 2,4-D were made by Pearson (50), Winders (63), Orchard (47, 48), Meadley (30), and Moore (33, 34) ; a large number of dicotyledonous weeds of crops, pastures and lawns were found susceptible.

The effects of phenoxyacetates and phenylcarbamates on weed-free cereals at various growth stages and rates of application were studied by Moore (35, 36). Subsequent research in Australia has been devoted to detailed field studies on the control of individual weeds and to plant physiological and biochemical investigations of the penetration, translocation (25, 26, 27) and mode of action of phenoxyacetic acid compounds (20).

Research on weeds in Australia is co-ordinated through the State Weeds Co-ordination Committees and specific weeds are allocated to State and Commonwealth institutions. Progress on the various problems and the weed control methods used in Australia are discussed briefly in the following paragraphs.

II. ANNUAL AND BIENNIAL WEEDS OF PASTURES

The most serious annual and biennial weeds of pastures are plants with spiny fruits or burrs which are deleterious to wool. Examples of such plants are Bathurst burr (*Xanthium spinosum*), Noogoora burr (*Xanthium pungens*) and Spiny emex (*Emex australis*). Plants with poisonous properties include mintweed (*Salvia reflexa*), wild heliotrope (*Heliotropium europaeum L.*) and crownbeard (*Verbesina encelioides*). Thistles of the genera *Cirsium*, *Carduus*, *Centaurea*, *Carthamus*, *Onopordon* and *Silybum* are widely distributed through the grazing regions. All of these species except *Emex australis* are susceptible to phenoxyacetic acid compounds ; the thistles and wild heliotrope being rather less susceptible than the others. Seedlings of spiny emex can be killed by 1% DNC activated with sulphate of ammonia (29). The capacity of these annual plants to retain seed viability in the soil means that spraying must be continued for several years ; in most cases control rather than eradication is all that can be expected.

In the winter rainfall zone the control of weeds can be achieved to a large extent by correct fertilizing and grazing, although spraying with phenoxyacetic acid compounds for the control of thistles is being practised to an increasing extent. Fortunately, the species of *Trifolium* in common use are relatively resistant to salts of 2,4-D and Methoxone (34).

III. ANNUAL AND BIENNIAL WEEDS OF CROPS

Striking successes have been achieved with synthetic hormone weedkillers in selectively controlling annual or biennial cruciferous weeds in cereal crops. Wild turnip (*Brassica tournefortii* Gouan), Ward's weed (*Vella annua*), Wild radish (*Raphanus raphanistrum* L.), Charlock (*Sinapis arvensis* L.), Turnip weed (*Rapistrum rugosum* (L) All.) and Buchan weed (*Hirshfeldia incana* Jusl.) have been controlled satisfactorily by rates of application as low as 2-3 ounces of 2,4-D or MCPA per acre. Large increases in crop yields have been reported (11, 18). Mintweed control in grain sorghum has been achieved also by low dosages of MCPA or 2,4-D (5). In Western Australia, DNC has been used for selective control of spiny emex in wheat (29). In Victoria, the same compound killed capeweed (*Cryptostemma calendula*) in flax ; the greatest increases in yields were obtained when sulphate of ammonia was omitted from the spray solution (10).

IV. PERENNIAL WEEDS OF CROPS

Considerable attention has been given to the control of deep-rooted herbaceous perennials. Hoary cress, the worst weed of the Victorian wheat belt (51) has been controlled effectively by two applications of MCPA or 2,4-D (37). Control of this weed has also been reported in South Australia (49) and Queensland (19).

After five years of intensive experimentation involving a wide range of phenoxyacetic acid compounds at different growth stages, no

permanent reduction of skeleton weed has been achieved. However, spraying infested crops has given substantial increases in wheat yield (38).

Control of Creeping knapweed (*Centaurea repens* L.), field bindweed, perennial thistle and other plants with lateral horizontal roots has been variable; even after repeated applications of phenoxyacetic acid compounds there is no surety of eradication.

Bulb and corm forming plants have been extremely difficult to control with chemicals. The most satisfactory control of cape tulips and soursob (*Oxalis cornua*) is achieved by ploughing when the carbohydrate reserves are at a minimum and prior to the formation of new cormlets (6). Reductions in nutgrass populations have resulted from applications of 2,4-D and MCPA (3 lb. of active ingredient per acre) but respraying did not increase the degree of control (39). Isopropyl phenylcarbamate applied as dusts and sprays, at rates up to 500 lb. per acre, was ineffective in field trials (39). Experiments in progress on nutgrass indicate that sodium trichloroacetate applied after cultivation is promising, but that maleic hydrazide has apparently little effect.

V. PERENNIAL WEEDS OF PASTURES

The use of chemicals on semi-arid grazing lands is not generally economic. In higher rainfall areas the use of phenoxyacetic acid compounds in association with highly competitive pasture species may be practicable. Selective herbicides used without competing plants have been unsuccessful on bracken fern, and of doubtful value on St. John's wort, ragwort and Crofton weed.

The Biological Section, Lands Department of Queensland, have successfully controlled burr ragweed (*Franseria* sp.); the amine and sodium salts of 2,4-D gave better results than esters. The same organization has reported complete kills of galvanized burr with 2 lb. per acre 2,4-D; MCPA gave poor results on galvanized burr but was effective on the closely related species *Bassia tetracuspis*. In New South Wales, Cuthbertson (15) found that the esters and amine salt of 2,4-D were better than the sodium salt for the control of galvanized burr.

Weir vine (*Ipomoea calobra* Hill & F. Muell.), a poisonous plant, has been killed by low rates of application of 2,4-D or MCPA (4).

VI. WOODY PLANTS

Esters of 2,4,5-T have been, in general, more effective on woody species than corresponding esters of 2,4-D. Blackberry and sweet briar (*Rosa rubignosa* L.) have been controlled by esters of 2,4,5-T but require more than one application (1, 41). Lantana, groundsel bush and hemlock (*Conium maculatum* L.) have been killed by repeated applications of 2,4-D compounds (4); better results were obtained by spraying young regrowth rather than old stems (18). Results with gorse (*Ulex europaeus* L.) have been conflicting and there is little evidence of satisfactory control of tea-trees (*Kunzea* spp. and *Leptospermum* spp.). African boxthorn (*Lycium ferocissimum* Miers) appears resistant to phenoxyacetic acid compounds (4).

Eucalypt regrowth has been killed by cutting and swabbing with 2% 2,4,5-T (5, 18); success with other tree species using this method has been reported (18).

VII. GRASS WEEDS

Studies of petroleum oil fractions have shown interesting relationships between aromatic content, mid-boiling point and toxicity (45). Oils high in aromatics have a rapid contact effect, but there is an inverse relationship between speed of action and kill of perennials such as *Paspalum dilatatum* Poir. High boiling point oils appear best for perennial tussock grasses and highly aromatic oils for annuals.

Rhizomatous grasses, e.g. *Cynodon dactylon* (L.) Pers., *Pennisetum clandestinum* Hochst. and *Sorghum halepense* (L.) Pers. have been eradicated by trichloroacetates (21, 40); the effectiveness of trichloroacetates appears to depend on rain following application. Oils are less effective than trichloroacetates on rhizomatous species but are superior on tussock forming species.

VIII. WEEDS OF IRRIGATION

The control of Cumbungi (*Typha* spp.) in irrigation channels by cutting and controlled water levels has been demonstrated by Prunster (52, 55). Hydrocarbon oils, such as diesel distillate, have been satisfactory for the control of *Paspalum dilatatum* on farm ditch banks during the watering season (45).

At the C.S.I.R.O. Irrigation Research Station, Griffith, experiments for the control of aquatic weeds, e.g. *Vallisneria* spp. and *Potamogeton* spp., by chlorinated benzenes and solvent naphthas are in progress. The Victorian State Rivers Commission are also actively investigating weed control in irrigation channels (57).

IX. BIOLOGICAL CONTROL

Biological control investigations of C.S.I.R.O. have been reviewed by Cashmore and Campbell (9). The control of St. John's wort has been described by Wilson (61) and Wilson and Campbell (62). Details of the successful campaign against Prickly pear have been given by Dodd (17). The possibilities of entomological control of other weeds, ragwort, Lantana and Crofton weeds, are being investigated.

Local control of Bathurst burr by a naturally occurring fungus, *Colletotrichum xanthii*, has been described by the N.S.W. Department of Agriculture.

X. DISCUSSION

It is evident from the foregoing that many of the serious weeds of Australia can be controlled by chemical methods. The use of chemicals by individual farmers is, however, largely a matter of economics. Complete eradication, even of annual weeds, is unlikely without changes in land management or utilization; such changes may, themselves, create new weed problems. The farmer and grazier needs, therefore, to

shift the balance of competition in favour of desirable plants. Whether chemical, manurial, cultural, grazing or crop rotation methods are used will depend on a number of factors.

There is increasing evidence that phenoxyacetic acid compounds at low rates of application (2-4 ounces per acre) may enable cereals to compete successfully with a wide range of dicotyledonous weeds and thereby produce yields comparable to those of weed-free crops. Even in the case of a perennial such as skeleton weed, which is not killed by heavy dosages of phenoxyacetic acid compounds, marked increases in yield have resulted from spraying infested wheat crops with low dosages (38).

It is unlikely that there will be an increasing use of herbicides in Australia on the lines suggested above. Once the farmer ceases to expect complete and final eradication he will use herbicides regularly for the same reason as fertilizers, namely, to increase production. In the case of cereals the susceptibility-growth-stage relationships have been determined for different phenoxyacetic acid compounds (36). Between tillering and booting there is little difference between compounds used at rates below 1 lb. per acre ; at higher rates MCPA is more selective than 2,4-D.

From Australian experience, the control of deep-rooted perennials by phenoxyacetic acid compounds seems to be assisted by, and may depend on, the presence of competing plants during the non-arable period. Although optimal dosage levels and compound growth-stage interactions exist their importance is minimized by the necessity of respraying (37).

There is some difference of opinion among Australian investigators concerning the relative merits of salts and esters of 2,4-D ; the different results obtained may be due to factors such as environment, growth-stage, cuticle thickness and their interactions. Esters penetrate more rapidly than salts and produce a faster kill of foliage ; rapidity of top-kill may result, however, in poor root kill of perennials and may be of little advantage in the case of annuals.

In general, low-volume applications of hormone-like herbicides give similar results to high volumes, but low volumes applied with ground equipment have been less effective than high volume-high pressure applications on woody plants. The relatively poor results achieved by low volume ground sprays on woody plants appear to be associated with poor coverage, as aeroplane applications show promise, particularly for controlling Eucalypt regrowth and brigalow (*Acacia harpophylla*) suckers. Oil as a carrier for 2,4,5-T esters in low volume ground applications appears less effective than water (41). Dusts have not been as effective as sprays in Australia.

In addition to those already mentioned, investigations in progress include, comparative studies of arsenicals, chlorates, trichloroacetates and para-chlorophenyl-l,l-dimethyl urea (CMU) as soil sterilants ; screening tests with a limited range of plant growth regulators and

inhibitors; control of weeds in pineapple plantations with pentachlorphenols, and the evaluation of dinitro phenols, pentachlorphenol, endothal and alkyl ethyl xanthates as contact herbicides.

The solving of many weed problems is seriously hampered by lack of knowledge of the life histories of the plants concerned. There is a distinct need for autecological and plant sociological studies on the important weed species of Australia. Some progress has been made along these lines by the initiation of ecological surveys of skeleton weed in New South Wales and Lantana in Queensland.

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TECHNICAL BREVITIES

This section includes information on plant protection problems in their widest sense, which has been obtained from published literature. We give references to the publications concerned.

INSECTICIDES

SUMMER FRUIT TORTIX CONTROL

FOR control of the summer fruit tortrix, *Adoxophyes orana*, in the United Kingdom, East Malling Research Station find that a delayed dormant winter wash of 0.1% DNC with 4% petroleum is useful, as also is 0.1% DDT applied at green cluster. Against the summer generation, two applications of 0.01% parathion or 0.15% toxaphene or 0.1% DDT are needed for good control, giving the first about the second week in June and the second about a fortnight later. If DDT is used, measures should be taken against build-up of red spider.

Groves, J. R., Comm. Grower, 1953, (2979) : 202.

WESTERN PEACH TREE BORER CONTROL

In Oregon the western peach tree borer, *Sanninoidea exitosa grafei*, can be effectively controlled without injury to trees by spring or autumn treatments against borers established in trees with ethylene or propylene dichloride, properly emulsified and diluted. Recommended strengths are 1 gal. in 3 gal. water for trees aged 6 years and over and 1 gal. in 4 gal. water for 4 to 5-year trees, made up with 2 oz. Tergitol 7 and applied at $\frac{1}{2}$ pt. per tree. Younger trees are liable to be injured, but it is suggested that a 15% emulsion may be tried on 3-and 2-year trees at $\frac{1}{2}$ pt. and $\frac{1}{4}$ pt. per tree respectively, and a $7\frac{1}{2}$% emulsion at $\frac{1}{8}$ pt. per tree for 1-year olds. Application may be made by spraying trunks at 80 lb. pressure or by pouring against the base of trunks or in a ring round the base and mounding. For control of larvae prior to their entering trees, summer application of concentrated DDT or parathion before egg hatching is excellent using 8 lb. per 100 gal. of 50% DDT or 15% parathion w.p. applied twice at $\frac{1}{2}$ to $\frac{3}{4}$ pt. per tree for trees of 1 to 3 in. diameter and at 1 to $1\frac{1}{4}$ pt. per tree for trees of 4 to 6 in. diameter. The trunks are sprayed from the first branches to the ground, and the soil around the tree bases. With annual applications from planting till trees are 8 or 9 years old there should be no future borer problem.

Brown, E., Bull. Oreg. Agric. Exp. Sta. No. 513, 1952, *pp.* 18.

FRUIT FLY CONTROL : ATTRACTANT FOR MALE ADULTS

Laboratory tests in Ceylon indicate that when soil is treated with ' Gammexane ' P 520 (crude BHC, 6% gamma isomer) most of the full-grown maggots of the cucurbit fruit fly do not work into the soil but pupate on the surface. Few flies emerge from such pupae, whether in or on the soil, and these are weak and deformed. An essential oil, " Dorana-tel " S, from the tree *Dipterocarpus glandulosus* attracts male adults of the fruit fly *Dacus ferrugineus dorsalis*, but not females.

Pinto, M. P. D., Adm. Rep. Dir. Agric. Ceylon, 1951 : 1952 : C51-C52.

SYSTEMIC INSECTICIDE APPLICATION TO TREE TRUNKS

Application of concentrated formulations of Systox to trunks of citrus trees gave high kills of citrus red mite, *Paratetranychus citri*, on the leaves and fruit, and some kill of citrus bud mite, *Aceria sheldoni*, in buds. Schradan was less effective. Methods of application were : (1) wrapping a saturated flannel cloth or a 0.5-in. thick absorbent cotton band round trunks and covering with Pliofilm ; (2) painting trunks with a formulation containing 50% active ingredient or a dilution of this with triethanolamine ; (3) spraying trunks and bases of primary limbs with the 50% emulsion formulation diluted with water.

Jeppson, L. R., et. al., J. econ. Ent. 1952, **45** (4) : 669-676.

MEALY BUG CONTROL ON VINE

Excellent control of the mealy bug, *Pseudococcus maritimus*, attacking outdoor vines was obtained in Western Australia with a 2% DDT emulsion spray, applied pre bud-burst. Very good results were also obtained with a ½% DDT emulsion, which strength is enough for general field use and appears to have little effect on the principal predators (ladybirds and lace-wings).

Forte, P. N., J. Agric. W. Austr. 3rd Ser. 1952, **1** (4) : 561-568.

CABBAGE FLY CONTROL

In France cabbage flies, *Chortophila* (*Erioischia*) *brassicae* and *C. E. floralis* can be controlled either by pre-planting or post-planting treatments against the larvae. As dusts applied to the soil before planting, the best results are given by gamma-BHC at 1.2 kg. per ha. or chlordane at 10 kg. per ha. or parathion at 7 to 8 kg. per ha. These treatments also destroy wireworms, white grubs and leatherjackets. Root dipping is effective only if planting is done shortly before or during the period of oviposition, for the larvae enter the roots three days after hatching. Complete control without plant injury is given by a 10 minute dip in a suspension containing parathion at 30 g. per hl. or chlordane at 150 g. per hl. Equally effective, but rather phytotoxic, is a suspension of tech. BHC at 240 g. per hl. DDT and inorganic mercury are poorer. From

2.5 to 3 hl. is needed per 1,000 plants. Watering the base of plants with 100 cc. insecticidal liquid is good if done within four days of planting or at the time of oviposition: a single treatment with chlordane at 150 g. per hl. or gamma-BHC in emulsion at 22 to 25 g. per hl. or parathion at 30 g. per hl. gives 90 to 100% control. Small scale trials indicate that toxaphene is highly phytotoxic, though aldrin and dieldrin are efficacious. Spraying with gamma-BHC emulsion or with chlordane or parathion is also good, if 50 to 75 cc liquid are used per plant and two treatments are given with an 8 to 10 day interval between. Dusting round the collar of plants with chlordane or gamma-BHC is also of value. Choice of method and number of treatments depends upon extent of damage and local conditions.

Bonnemaison, L. and Missonnier, J., C.R. Acad. Agric. Fr. 1952, **38** (14): 581-583.

Cabbage root fly is very effectively controlled by 'Agrocide' Dispersible Powder at the standard recommendation of 4 lb. per 100 gallons of water (Fernhurst Research Station, Plant Protection Ltd.).

SYMPHILID DAMAGE TO TOMATO

Symphilids (*Scutigerella immaculata*) are attracted to the roots of young tomato plants and cause damage which renders these liable to attack by fungi. In ball-watering trials in the United Kingdom, 20% parathion at 1 fl. oz. per 10 gal. gave rapid and complete control of the symphylids without injury to the plants. Complete control, but with some hardening of plants, was obtained with mercuric chloride at 1 oz. per 10 gal. and with 20% DDT wettable powder at 3 oz. per 10 gal. BHC wettable powder (dose not stated) gave good control but caused marked hardening. Schradan at 1 fl. oz. per 10 gal. gave a fair kill without plant injury. HETP gave no kill. Parathion is recommended for use where symphylids are present in dangerous numbers.

Staniland, L. N. and Stone, L. E. W., Plant Path. 1952, **1** (3): 87-88.

In trials at Fernhurst Research Station, Plant Protection Ltd., 'Fosferno' 20 at a dilution of 10 fl. oz. per 100 gallons of water has been found to be effective against symphilids.

GREENBUG CONTROL ON WHEAT

Effective control of the greenbug, *Toxoptera graminum*, on wheat in Texas was given by parathion in dust or spray emulsions at 0.3 to 0.5 lb. per ac. and by BHC dusts at 0.5 lb. gamma isomer per ac. Metacide and Systox sprays also gave good results. Schradan was not effective. Parathion sprays were effective when applied by airplane at 0.37 lb. wettable powder per ac. using 2 gal. per ac. and water as diluent. The materials acted best at temperatures over 50° F. when the bugs were feeding on the leaves. In all cases, more than one application was needed to prevent damage.

Owen, W. L., et al. Progr. Rep. Texas Agric. Exp. Sta. No. 1458, 1952: *pp.* 4.

EFFECT OF WHITE GRUB CONTROL BY BHC ON SUGAR CONTENT OF CANE

In Queensland a slight attack on sugar-cane by greyback grubs (*Dermolepida albohirtum*) may cause a rise in sugar content owing to early cessation of growth as a consequence of root damage, whereas a moderate to severe attack causes a serious loss of sugar. Soil applications of BHC, by controlling the pest, may result in a loss of the benefit of the higher sugar content in cane that is very lightly infested, but in general the overall return from grub-damaged cane is far less than from cane in which the grubs have been controlled. BHC at grub control rates has no direct effect on sugar content.

Wilson, G., Cane Gr. quart. Bull. 1950, **14** (2) : 73-75.

TOBACCO PEST CONTROL : GENERAL SCHEDULE

Notes are given on the life histories of the more important field pests of tobacco in Queensland and on their control. As a general control schedule it is recommended to sterilize beds and paths before planting, to sand beds $\frac{1}{8}$ in. deep after planting against seed harvester ants, and, about two weeks after germination, to spray weekly with 0.1% DDT when the last daily watering has been done to prevent establishment of leaf miner and stem borer. Before transplanting, seedlings should be thoroughly sprayed with DDT-lead arsenate. In the field, DDT-lead arsenate should be sprayed or dusted weekly for the first three weeks. A lead arsenate bran bait may be applied against budworm.

Smith, W. A., Qd. Agric. J. 1952, **75** (2) : 85-104.

HELIOTHIS CONTROL IN LINSEED

The most effective method of controlling *Heliothis armigera* in linseed in Queensland is boom spraying with DDT emulsion at 1 lb. DDT per ac. One treatment during flowering, shortly after the moths become active, is normally enough. Adequate cover is given by 15 gal. per ac.

CHRYSANTHEMUM GALL MIDGE CONTROL

The chrysanthemum gall midge, *Diarthronomyia hypogaea*, is a serious pest of greenhouse chrysanthemums in Connecticut. The larvae bore into the plant tissues, causing galls in which they pupate. Lindane in emulsion form at 1 : 3200 or stronger kills larvae and pupae while these are still in the galls and also destroys the midge without injury to plants. It is recommended to spray twice, with a 5 to 6 day interval between, using lindane emulsion at 1 pt. per 100 gal. (a teaspoon per gal.) or wettable powder at 1 to 1.5 lb. per 100 gal. (4.5 to 7 g. per gal.).

Schread, J. C., Bull. Conn. Agric. Exp. Sta. No. 554, 1952, *pp.* 6.

WEBWORM DAMAGE TO PASTURES

In subterranean clover pastures in Western Australia, heavy infestations of larvae of webworms, tentatively identified as *Talis pedionoma*, may reduce yields of grass by as much as 88% and total production of the pasture by 50%. Excellent control is given by acre application of 90 lb. superphosphate including 0.25% DDT dust.

Wallace, M. M. H. and Mahan, J. A., J. Austr. Inst. Agric. Res., 1952, **18** (2) : 91-94.

DDT PERSISTENCY IN SOIL

United States Department of Agriculture tests show that a single application of DDT to soil will kill some insects for at least 5 years. The average carry-over in turf was 92% after 2 years, 43% after 4, 36% after 6, and 29% after 7. Rate of application had little influence on the percentage of toxic residue in the soil. DDT lasted longer in poor soils and a shorter time in soils rich in organic matter. Persistence was about the same in different loams, but was much greater in soils heavy in sands.

Agric. Chemic., 1952, **7** (9) : 71.

YELLOW-STRIPED ARMYWORM CONTROL : EFFICIENCY OF EPN

The yellow-striped armyworm, *Prodenia ornithogalli*, which is a pest of cotton and other crops in Mississippi, is resistant to most of the chlorinated hydrocarbon insecticides. EPN was by far the most effective of 11 insecticides tested against it and gave excellent control at 0.1 lb. per ac. and perfect control at 0.2 lb. per ac. No other organic phosphate was used in the trials.

Lowry, W. L. S. and Colhoun, S. L., J. Econ. Ent., 1952, **45** (4) : 741.

EELWORM CONTROL : EFFICIENCY OF SYSTEMICS

In Florida ammonium dinitro-o-cresylate is very toxic to nematodes, but when applied to the soil it is also very toxic to plants. Fairly toxic to nematodes were benzoic acid allyl ester and acetic acid 3,4-dichlorobenzyl ester. The most effective systemics tested against root knot nematodes within the roots of living plant were Systox and C1-O3.

Christie, J. R. and Perry, V. G., Rep. Fla. Agric. Exp. Sta., 1951 (1952) 136-137.

PARATHION TOXICITY TO MAMMALS : HAZARD FROM VAPOUR AFTER SPRAYING

After spraying a citrus grove in Florida, the maximum concentration of parathion vapour found was 0.005 p.p.m. This remained for five days, and the concentration then dropped to undetectable levels.

Warm-blooded animals showed no effects from continuous exposure to parathion for 168 hr. This indicates that it may be safe for persons to enter groves after application of parathion and remain there for long periods of time, provided they do not contact limbs and foliage of the trees. Bird life and small animals should not be adversely affected in sprayed groves.

Stearns, C. R., Rep. Fla. Agric. Exp. Sta. 1951 (1952) : 157-158.

FUNGICIDES

MERCURY SPRAY RESIDUES ON APPLES

Experiments in Indiana showed that residues of mercury on apples at harvest time from several sprayings with commercial organo-mercurials should not exceed a few parts per 1,000 million unless spraying was done late in the season. Apples and leaf surfaces covered with cellophane after spraying showed no more residue than uncovered areas, demonstrating that factors other than rain reduce the residue. High orchard temperatures causing volatilization of mercury and light catalyzing its breakdown are thought to be involved.

Ford, A. W. and Burkholder, C. L., Agric. Chemic., 1952, **7** (7) : 44-47, 123.

APPLE SCAB INFECTION FROM BUD SCALES

In the United Kingdom infection from apple scab (*Venturia inaequalis*) on the apple variety Bramley's Seedling can start in spring from pustules on bud scales. This may explain why in the Wisbech area, where the low-lying orchards on a very fertile soil seem to provide ideal conditions for bud infection, as many as nine lime-sulphur sprays fail to give satisfactory control in some seasons. The presence of scab on the bud scales emphazises the need for well-timed pre-blossom sprays and possibly explains why some growers in this area favour a strong lime-sulphur spray at or soon after bud break.

Weston, W. A. R. D., Gdnrs'. Chron., 1952, **132** (3436) : 195.

SEED TREATMENT OF BEANS

Results are given of three years' work in Michigan on the improvement of stands of beans by seed treatment. Thirty-five proprietary dressings were tested and both dry and slurry method of applications were used with several of these. A list of recommended dressings is given, which includes ' Agrox .'

Andersen, A. L. and de Zeeuw, D. J., Quart. Bull. Mich. Agric. Exp. Sta., 1952, **34** (4) : 357-364.

SEED TREATMENT OF PEAS

Results are given of three years trials in Michigan with a range of seed dressings for the control of damping-off and seed decay (organisms not specified) of peas. Results varied from year to year and from

variety to variety. Phygon, Phygon XL and Semesan were best over 3 years but Ceresan M, Arasan, Arasan SF, C & CL—640, C & CL-224, and Panogen were good in some seasons. Tested once only (1951) 'Agrox' was significantly better than Arasan, Arasan SF, and Ceresan M: Phygon XL, Semesan and Orthocide 406 were equal to 'Agrox.' Comparison between dry and slurry methods of application indicated that either was satisfactory except with Ceresan M which, as a slurry, might be harmful on certain varieties.

Andersen, A. L. and de Zeeuw, D. J., Quart. Bull. Mich. Agric. Exp. Sta., 1952, **35** (1) : 25-33.

CONTROL OF BLACK SCURF OF POTATO

Black scurf caused by *Corticium solani*, which is serious on seed potatoes sorted under damp conditions or planted in wet soil, is controlled in Holland by organo-mercurials applied as autumn dips at strengths of 0.15 to 0.5%. Using a 0.15% solution, the tubers should be immersed for 20 to 30 min. and 22 gal. should do for three lots of 3 cwt. of tubers without replenishment. By addition of 1 gal. water containing a double quantity of the mercury compound, the bath can be used for six batches. In a 0.05% solution dipping time can be cut down to 1 min. and the solution can be used twenty times if 1 gal. double strength is added per 22 gal. after each treatment.

Fertil. Feed. St. J., 1952, **38** (26) : 854.

BLACK ROOT OF RADISH

Results are reported of extensive investigations in Germany into the biology of *Aphanomyces raphani*, the cause of black root of radish. Cultural characteristics of the fungus are described, including germination of oospores, which was observed for the first time. Radishes of all ages are attacked except the earliest seedling stage. Incidence of the disease is not connected with boron nutrition of the host, but is favoured by poor soil conditions. The disease cannot be controlled by seed dressing, and a sure decrease can be obtained only through cultural measures including heavy mineral manuring, crop rotation, and seed selection.

Herold, F., Phytopath. Z., 1952, **19** (1) : 79-125.

RUST AND LEAF BLIGHT OF SWEETCORN CONTROL

Both rust (*Puccinia sorghi*) and leaf blight (*Helminthosporium turcium*) of sweet corn were well controlled in Florida by 11 dustings in 55 days of 10% Dithane-Z 78 (zineb 65%) at 50 lb. per ac. A 5% dust was nearly as good.

Townsend, G. R., Plant Dis. Reptr., 1951, **35** (8) : 368-369.

SEED TREATMENT OF COTTON FOR BLACKARM CONTROL

In Uganda experiments in cotton seed treatment with 'Perenox' against blackarm disease have been so successful that the Department of Agriculture prophesy a 60% increase in cotton production within the next few years. Authority has been given for setting up eleven dressing stations in addition to the existing two.

New Commonw., 1952, **24** (8) : 389.

LEAF DISEASE OF RUBBER CONTROL : PRESCRIBED TREATMENT IN CEYLON

In Ceylon the Director of Agriculture officially prescribes that leaf disease of rubber caused by *Oidium heveae* should be treated by annually dusting with sulphur all rubber trees excepting those in areas of less than 50 ac., those growing at or over 1,000 ft. above sea level, those under 6 years of age, and those having an average yield of 500 lb. per ac. or below. Dusting must start before 50% of trees have defoliated, giving at least 5 applications at 7-day intervals for monoclonal rubber and 8 applications for seedling rubber, using 12 lb. per ac. for each round. The powder should contain at least 85% pure sulphur and 90% of it should pass through a 300-mesh sieve. The dusting appliance must be approved. Other methods of control may be carried out only with written approval of the Director of Agriculture.

Joachim, A. W. R., Ceylon Govt. Gaz., 1952, (10,448).

MISCELLANEOUS

SUDDEN-DEATH DISEASE OF CLOVE : ASSOCIATION WITH A FUNGUS

Sudden-death disease of the clove tree in Zanzibar is found to be invariably associated with a fungus of *Valsa* sp. The absorbing roots die at an early stage of the disease and *Valsa* can be isolated from them. The fungus has never been found in trees killed by agencies other than sudden-death disease, nor has any other fungus been consistently associated with the disease. Experiments show that *Valsa* can readily invade mature trees, that young trees are resistant, and that seedlings are immune. A root rot associated with *Valsa* is considered to be a form of sudden-death disease.

Nutman, F. J. and Roberts, P. M., Nature, Lond., 1953, **171** (4342): 128.

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